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(54) METHOD AND APPARATUS FOR FILTERING SUSPENSIONS

(71) We, VOGELBUSCH GESELLSCHAFT m.b.H., an Austrian Body Corporate, of Mautner Markhof-Gasse 40, 1110 Vienna, Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process and an apparatus for filtering suspensions on rotating filters, for example on a vacuum operated rotating filter drum the interior of which is non-subdivided, on which the filtrate is centripetally moving under the influence of a pressure difference, in which process and apparatus the suspension to be filtered is applied to the filter surface and to a precoat of filter aid material which has been previously applied to said filter surface and is filtered to form a filter cake. Subsequently the remaining liquid portion retained in the filter cake is, if desired after removal of excessive suspension from the filter, as far as possible filtered off, and the liquid retained in the capillaries of the filter cake is, if desired, displaced by another liquid and finally the filter cake together with a layer of the optionally present precoat of filter aid material is removed from the filter. With known rotating filters of the kind described the suspension to be filtered is continuously applied to the filter, e.g. by immersing a portion of the filter drum into a trough filled with a suspension to be filtered, and the layer of suspension on the rotating filter is, if desired, made to be of uniform thickness by a wiper member, and subsequently the filter cake is removed from the filter drum at an area in front of the position where the rotating filter drum enters the trough. With known rotating filters of the kind described the filter drum is continuously immersed into the trough so that the filtrate may be sucked out of the layer of suspension adhering to the filter surface and out of the filter cake. The filter cake is sucked dry while rotating with the drum between the point at which the filter cake leaves the surface of the suspension in the trough and the point at which the filter cake is removed from the drum. Thus the period available for drying the filter cake is shorter than the period required for one single revolution of the drum. If the liquid retained in the capillaries of the filter cake is to be displaced by another liquid prior to removal of the filter cake, a still shorter period is at disposal for filtering the suspension and sucking dry the filter cake.

In filters of the kind described, frequently a so-called precoat is provided, which consists of a coating of filter aid material which is applied to the filter cloth prior to starting the filtration, the filtrate subsequently passing through the filter aid coating under the influence of an applied vacuum. When utilising such a precoat it may became necessary to remove the outermost layer of the precoat when removing the filter caker if the precoat has become clogged by the solids contained in the suspension. In known apparatus this is effected simultaneously with the removal of the filter cake. The time interval which is available for sucking the filter cake dry during less than one single revolution of the filter drum is frequently insufficient for satisfactorily sucking dry the filter cake so that removal of the filter cake and, if necessary, of the outermost layer of the precoat, becomes extremely difficult. This inconvenience is quite remarkable when filtering suspensions having unfavourable filtration characteristics.

The present invention seeks to obviate or mitigate the above mentioned drawbacks of known rotating filters.

According to the present invention there is provided a process for filtering a suspension on a rotating filter on which filter the filtrate is drawn into the rotating filter under the influence of a pressure difference and which process comprises the steps of applying said suspension to said filter and filtering the suspension, the application of the suspension to be filtered being interrupted during one or more complete revolutions of the filter to enable the suspension applied

to the filter to be filtered off and subsequently removing a resultant filter cake from the filter.

In this connection it is convenient to apply the suspension to be filtered to the filter, to filter the suspension and to remove the filter cake repeatedly in cycles. In utilising the process of the invention the time required for sucking dry the filter may, independently of other filtering requirements, be extended at will. These features may enable optimal working conditions to be obtained, and additionally suspensions of unfavourable filtration characteristics may be filtered satisfactorily.

The filter cake formed on the filter and/or a precoat optionally present may contribute to the filtering action. As long as the thickness of the filter cake is low the filter and/or the precoat is subjected to more severe load, particularly when filtering suspensions which give rise for clogging the filter pores. In such circumstances the filter cake produced prevents the pores of the filter surface and/or the precoat from becoming clogged, because such pores are protected by the filter cake. In utilising the process of the present invention the period available for sucking the filter cake may be greater than in utilising prior methods and thus a filter cake of greater thickness than heretofore may be sucked dry, and thus the effective life-time of the filter and of the precoat may be increased. However, if the filter cake becomes too thick the filtering speed is decreased and also the efficiency of the filter is decreased. For this reason it is advantageous to apply the suspension to be filtered onto the filter until a filter cake of predetermined thickness has been formed, and thus, expediently the supply of the suspension to the filter may be interrupted in dependence upon the thickness of the filter cake. Removal of the filter cake may be effected after completing at least one complete revolution of the filter, or expediently after completing several revolutions of the filter, subsequently to interrupting supply of the suspension to be filtered onto the filter. Thus an adequate period of time for sucking dry the filter cake may be provided after interrupting the supply of the suspension to be filtered to the filter. The period of time is thereby not subjected to restricting conditions existing up till now, e.g. the condition that the complete filtering cycle must be completed during the time necessary for one single revolution of the filter drum. In utilising the invention the suction of the liquid portion remaining in the filter cake may expediently be effected after interrupting the supply of the suspension to be filtered onto the filter and said period may be long enough for attaining a desired and predetermined filtrate concentration or humidity content in the filter cake. In this case, removal of the filter cake may be commenced in dependence on the humidity content of the filter cake. The optimum thickness of the filter cake is in turn dependent on the quality of the suspension to be filtered, so that said optimum thickness must be preselected if interruption of the supply of the suspension to be filtered onto the filter is to be satisfactorily controlled in dependence on the thickness of the filter cake. Control of interruption of the supply of the suspension can, therefore simply be effected according to a preselected programme and such a control according to a preselected programme is, as a rule, sufficient for defining the duration of each of the single filtering stages.

For obtaining a uniform filter cake and also a uniform filter efficiency at all areas of the circumferential surface of the filter drum conveniently the thickness of the layer of the suspension to be filtered and present on the filter is equalised around the periphery of the filter at least near the end of the period of supplying the suspension onto the filter, and preferably continually during the total period of supplying said suspension, because thickness of said layer of suspension present on the filter cake may influence the thickness of the filter cake formed. Supply of the suspension can be effected continuously or intermittently during the period of applying suspension to the filter. It is possible to interrupt the application of suspension to be filtered onto the filter when the filter cake formed has assumed a predetermined thickness. After interrupting application of the suspension, excessive suspension can be removed from the filter.

Conveniently filtering off of the liquid retained in the filter cake after interrupting the application of the suspension to be filtered can be effected until a predetermined degree of humidity of the filter cake is attained, and it is further possible to displace, prior to removal of the filter cake from the filter, the liquid contained in the capillaries of the filter cake at least partially by another liquid. Since the supply of the suspension to the filter is interrupted prior to removal of the filter cake, there may be no time limitation for these operations and optimal working conditions may be provided.

Further, also the circumferential velocity of the filter is not limited by the condition that sucking dry of the filter cake must be completed within less than one single revolution of the filter drum. If the revolution speed of the filter drum is too low it is possible that the suspension to be filtered may flow off the filter surface in too great a quantity, whereas with high revolution speeds of the filter drum the suspension may be removed from the filter surface by centri-

fugal forces. If there is an excessively high relative velocity between the suspension and the filter surface formation of the filter cake can be disturbed and under certain circumstances even precoat material may be rinsed off the filter. The filter surface should be enclosed by a layer of suspension to be filtered while applying said suspension to the filter surface. The circumferential velocity of the filter drum of an apparatus in accordance with the invention may advantageously be in the range 0.5 to 2 m/sec in the case of a vacuum actuated rotating filter drum. Such circumferential velocities are favourable when removing the filter cake by means of a peeling knife, which, when working with such velocities, may give a smooth cut. It would be possible to increase the circumferential velocity of the filter solely during removal of the filter cake, however, the circumferential velocity is preferably kept constant, because the above mentioned circumferential velocities are sufficient for producing a smooth cut by means of a peeling knife or an equivalent tool.

The sucking pressure (a sub-atmospheric pressure) within the filter drum could be increased (resulting in a lower pressure difference between the pressure of the drum and atmospheric pressure) during removal of the filter cake so that an excessive amount of air is prevented from entering the filter drum, which could lower the quality of the filtrate and could give rise to foam formation. However, in practice it has been found that it is convenient to keep the sucking pressure within the filter drum constant during the complete filtering cycle.

According to a further aspect of this invention there is provided an apparatus for performing the above described process, said apparatus comprising a trough for a suspension to be filtered and a filter drum for being at least partially immersed into said trough, the interior of said drum constituting a single chamber, means being provided for varying the distance between the axis of the filter drum and the liquid level within the trough between an amount smaller than the radius of the filter drum and an amount greater than the radius of the filter drum. Control means may be provided for making the filter cake removing means operative and inoperative, and said control means may be actuated arbitrarily or automatically, either in dependence on an operating condition or in dependence on a predetermined programme. Known rotating filters usually are provided with a trough to be filled with suspension to be filtered, whereby the filter drum is continuously at least partially immersed into said trough. However in one apparatus in accordance with the invention the arrangement is such that the distance between the axis of the filter drum and the liquid level within the trough can be varied between an amount smaller than the radius of the filter drum and an amount greater than the radius of the filter drum. In this connection, the trough and/or the filter drum may be supported for relative lifting and lowering movement, but it is also possible to adjust the liquid level within the trough, e.g. by means of an immersing body which may be immersed in the liquid to raise the level thereof. Uusually the liquid level within the trough containing the suspension is controlled by a floating body. For avoiding excessive raising of the liquid level within the trough on immersion of the trough or of the immersing body into the trough, the arrangement can be such that a valve is interconnected into the supply conduit leading into the trough which renders said supply conduit operative only with the filter drum immersed into the trough or with the immersing body immersed into the trough.

However, it is also possible to provide at least one distributing tube for applying the suspension to be filtered onto the filter drum, and in this case it is convenient to provide a closure member upstream of the mouth of the distributing tube. By means of such a distributing tube, the suspension to be filtered may be poured or sprayed onto the filter drum, and in this case it is obviously also possible to collect excessive amounts of suspension in a trough arranged below the drum. In this manner it is possible to arbitrarily select the mode of supply of the suspension onto the filter drum.

For removal of the filter cake and optionally for removal of a surface layer of the precoat, generally a peeling knife may be provided. Such a peeling knife may be pivotably mounted and may be pivotable into the operating position and pivotable out of the operating position conveniently by means of pneumatic cylinders. The peeling knife, and conveniently also a wiper provided for removing excess suspension from the filter drum, may be supported on a slide arranged for sliding movement towards the filter drum. If a wiper is provided, the slide for the wiper and the slide for the peeling knife can be positively coupled for simultaneous movement towards the filter drum, because the decrease of the effective diameter of the filter surface when peeling the precoat has to be considered for both the wiper and the peeling knife.

It is necessary for a smooth cut and a long effective life time of the precoat coating that the peeling knife be maintained in a sharp condition. If the peeling knife is not in a sharp condition parts of the precoat material can be torn out of the precoat even when only peeling the filter cake. Damaged areas of the precoat can only be removed by peeling the precoat for a depth corre-

sponding to the depth of the damaged areas, which results in a heavy consumption of precoat material. If, on the other hand the precoat has only to be freed of the clogged pores present on the upper surface of the precoat it is sufficient to only peel off a surface layer of the precoat. However, for removing such a thin surface layer it is also necessary that the peeling knife be sharp enough.

In known apparatus of the kind described the peeling knife had to be frequently manually cleaned or frequently interchanged with a new knife, and consequently operation of the apparatus was frequently interrupted. In a preferred embodiment of the present invention a scraper may be provided with which the peeling knife is in sliding engagement during the movement of the knife into the inoperative position, the scraper preferably also engaging the cutting edge of the peeling knife in the later stages of the movement of said knife into the inoperative position. During sliding engagement of the plane surface of the peeling knife facing the drum with the scraper this plane surface is freed of adhering filter cake material when the knife is moved from its operative position in its inoperative position. Therefore, the surface of the peeling knife brought into contact with the precoat behind the cutting area is quite clean, and thus this surface is smooth and is not roughened with deposits thereon, otherwise, this surface would damage the precoat. Said arrangement is particularly advantageous. If additionally, the peeling knife is moved into a position in which the scraper also slides over the cutting edge of the knife, the abrasive action effected results in sharpening the cutting edge of the knife, which therefore remains sharp because such movement is frequently repeated. Such an arrangement provides a smooth cut produced by the peeling knife. Such an arrangement is also advantageous if only the filter cake is to be removed and this filter cake is inclined to tear precoat material out of the precoat. Further, clogged pores of the precoat can be readily removed with a sharp peeling knife which also enables the layer of precoat removed when removing the clogged pores to be as thin as possible, so that the effective life time of the precoat is maximally increased. The arrangement described may prove reliable even if the precoat material contains hard particles as is the case with infusorial earth (essentially consisting of pure SiO_2) or with perlites (vulcanic glass).

The scraper may conveniently consist of a resilient steel sheet resiliently engaging the peeling knife. Such a prestressed resilient steel sheet may act with its edge on the surface of the peeling knife facing the drum and may keep said surface clean. The abrasive effect of such an essentially smooth steel sheet is comparatively low, which, however, is quite desirable because the cutting edge of the peeling knife is sliding on said sheet on each movement into the inoperative position and a heavy abrasive effect would reduce the effective life time of the peeling knife. The mentioned low abrasive effect is, however, sufficient for keeping the cutting edge of the peeling knife sharp.

In order that the invention may be more readily understood and so that further features thereof may be appreciated, embodiments of an apparatus in accordance with the invention, and a process for filtering a suspension in accordance with the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 shows a cross-section of a filter drum of a filtering apparatus in its operating position,

Figures 2 to 7 illustrate various stages of one operation cycle of the apparatus of Figure 1, and

Figures 8, 9 and 10 show, on an enlarged scale, a peeling knife together with a device for cleaning and sharpening said knife for use in the apparatus of Figure 1, Figure 8 showing the peeling knife in the working position with respect to the filter drum and Figures 9 and 10 illustrating inoperative positions of said peeling knife, Figure 9 illustrating that inoperative position in which a scraper is cleaning the peeling knife and Figure 10 showing that inoperative position, i.e. the end position, which is reached by the peeling knife after the cutting edge of the peeling knife has been slidingly moved along the scraper.

Referring to Figure 1 on the perforated mantle of a filter drum 1 a filter cloth 2, e.g. a filter cloth of stainless steel, is put under tension. A coating 3 of filter aid material, a so-called precoat, e.g. a coating consisting of powdered starch, is maintained in engagement with the filter cloth 2 by a vacuum prevailing in the interior of the filter drum.

When applying a suspension to be filtered to the thus prepared surface of the filter drum a filter cake 4 is formed by the solids of the suspension, and on the surface of said filter cake 4 a layer 5 of the suspension to be filtered is present. In operation, the filter drum 1 is rotated in direction of the arrow shown in Figure 1 and a vacuum is produced within the filter drum 1 by a vacuum source (not shown) via a suction conduit 6, through which the filtrate is sucked out of the filter drum 1. A trough 7 is filled with the suspension 8 to be filtered and the trough 7 can be pneumatically lifted or lowered by means of the pneumatic cylinder 9, so that, with the drum rotating, it is possible to intermittently partially immerse the filter drum 1 into the suspension and the filter cake 4 is covered

by a layer 5 of the suspension to be filtered.

A peeling knife 10 is shown in Figure 1 in its rest position. The peeling knife 10 can, by means of a pneumatic cylinder 12 and a crank lever 11 be swung towards the filter drum 1 to such an extent that it is peeling off the filter cake 4 and, if desired, the uppermost layer of the coating 3 consisting of filter aid material. The peeling knife 10, the crank lever 11 and the pneumatic cylinder 12 are arranged on a slide 13, which in its turn is provided with a tooth-rack 35 engaged by a toothed gear 14. The toothed gear 14 is intermittently driven via a worm 15 and a worm gear 36 by means of a latch wheel 16 coupled to the shaft of the worm 15 and being engaged by a latch 17 which in turn is arranged for reciprocating movement by means of a pneumatic cylinder 18. When the pneumatic cylinder 18 is operated the slide 13 is gradually moved in direction to the filter drum 1 so that the peeling knife 10 in successive operational cycles of the apparatus gradually peels off the uppermost layer of the filter aid coating 3. Supply of the actuating fluid for the pneumatic cylinder is controlled by electric pulses which are produced in dependence on the necessary change of the working position of the peeling knife 10, e.g. according to a preselected programme. A sprocket wheel 37 is coupled to the axis of the toothed gear 14 and the worm gear 36 so that this sprocket wheel 37 is, via a crossed sprocket chain 19, in driving connection with a further sprocket wheel 38 mounted with a further toothed gear 20 on a common shaft. This further toothed gear 20 is in driving engagement with a tooth rack 39 of a slide 21 so that the slides 33 and 21 are driven towards filter drum 1 in equal increments. A wiper blade 22 consisting of elastic plastics material is fixed to a crank lever 23 in a manner similar to the mounting of the peeling knife 10 to the crank lever 11. Said crank lever 23 can be pivoted by means of a pneumatic cylinder 24. The slide 21 is further provided with a wiper element in the form of a limiter blade 25 serving the purpose of defining the thickness of the layer 5 of the suspension to be filtered and further serving the purpose of equalising the thickness of said layer 5.

Figure 1 illustrates how a portion 26 of the suspension to be filtered is wiped off by the limiter blade 25 and then flows back to the trough 7.

At a certain distance from the surface of the filter drum 1, a plurality of spray nozzles 27 is arranged. Washing liquid may be supplied to the surface of the filter drum via said spray nozzles 27. In the operating stage illustrated by Figure 1 the spray nozzles are inoperative since the supply of washing liquid has been terminated by valve 28, which can be actuated by a pneumatic cylinder 29.

The suspension to be filtered is fed to the trough 7 via a conduit 30, the end of which is closed either by a ball valve 33 or a valve 32 actuated by a float 31. In the uppermost position of the trough 7, the ball valve 33 is opened by an actuating stem 34, fixed to the trough 7. With this arrangement the proper level of the suspension within the trough 7 is maintained, so that on immersion of the filter drum into the trough 7, suspension will not flow over the rim of the trough.

If desired, provision can be made for cleaning the peeling knife of adhering residues of the filter cake or filter aid while the knife is inoperative, so that the filter aid coating cannot be damaged by said residues when the peeling knife comes into re-engagement with the coating on the filter drum.

A vacuum-operated rotating filter drum not provided with cells in the interior of the filter drum (non-subdivided) and operated without a filter aid coating, would differ from the rotating filter illustrated in Figure 1 by the filter aid coating 3 being omitted and substituted by a thinner filter cake. Also the parts for the engaging movement of the peeling knife 10 and of the wiper blade 22 may be omitted.

Figures 2 to 7 illustrate the various operating stages during one cycle when operating a precoated filter drum.

During the first operating stage (Figure 2) the filter drum 1 provided with filter aid material coating 3 (precoat) is partially immersed into the suspension 8 contained within the trough 7, because the trough 7 is lifted in its uppermost operating position by the pneumatic cylinder 9. A suspension layer 5 is formed on the filter surface of the rotating filter drum and completely encloses the filter surface. In the area between the suspension layer 5 and the filter aid coating 3 a filter cake 4 is formed while the filtrate enters the interior of the filter drum and is withdrawn via the suction conduit 6 (Figure 1). In this operating stage the peeling knife 10 and the wiper blade 22 are in a retracted position with respect to the filter drum 1 and the spray nozzles 27 are inoperative. If it is intended to avoid excessive agitation and foaming of the suspension within the trough 7, it is possible to lower and lift the trough 7 several times during said operating stage, so that the suspension 8 is applied intermittently to the filter drum 1.

When application of the suspension to the filter drum has been terminated the second operating stage (Figure 3) is started. For this purpose the wiper blade 22 is swung towards the filter drum 1 under the influence of the actuated pneumatic cylinder 24 and thus wipes off any excessive suspension 5 adher-

ing on the filter cake 4. The excess of the suspension 5 flows back into the trough 7, which in the meantime has been lowered. After passing the wiper blade 22 only a little amount of liquid suspension or no suspension at all remains on the filter cake 4. The peeling knife 10 and the spray nozzles 27 are still inoperative in this operating stage.

Subsequently the third operating stage (Figure 4), i.e. drying of the filter cake, is started. In this operating condition the trough 7 is maintained in its lowered position and peeling knife 10, wiper blade 22 and spray nozzles 27 remain still inoperative. This operating stage is maintained for a time interval sufficient to achieve the desired dehydration of the filter cake, i.e. until a moment at which the filtrate is essentially completely sucked out of the filter cake.

During the fourth operating stage (Figure 5) the liquid still contained in the cake 4 by capillary action is displaced. For this purpose, the valve 28 of the spray nozzles 27 is actuated by means of the pneumatic cylinder 29 for spraying a displacing liquid 40, e.g., pure water, onto the surface of the filter cake 4. Spraying of the displacing liquid onto the surface of the filter cake may be effected several times. At the right moment prior to the end of the fourth operating condition, the valve 28 is closed again so that the filter cake 4 becomes dry again before removal thereof. The trough 7 is in its lowered condition and the peeling knife 10 and the wiper blade 22 are inoperative.

During the subsequent fifth operating stage (Figure 6) the peeling knife 10 is swung towards the filter drum and thus peels the finished filter cake 4 off the underlying filter aid coating 3. The filter cake 4 removed from the filter drum slides down along the inclined surface of the peeling knife 10 and can be collected by a suitable means and subjected to further treatment. During the fifth operating stage the trough 7 is maintained in its lowered position and the wiper blade 22 as well as the spray nozzles 27 are inoperative.

Figure 7 illustrates the filter during the sixth operating stage. In this operating stage neither suspension to be filtered nor filter cake are present on the filter surface in substantial amounts. Now, by means of the pneumatic cylinder 18 and the latch 17 connected thereto, the latch wheel 16 is rotated by one latch step so that the peeling knife 10 is shifted towards the filter drum 1 by a minute amount. In the now assumed position, the peeling knife 10 is removing a thin layer from the filter aid coating 3 and is thus cleaning the surface of said filter aid coating so that a suitably permeable filter aid coating is presented for the next operating cycle, and the cycle recommences at the first operating stage thereof. If desired, the filter aid removed can be separately collected from the filter cake peeled off. Simultaneously with the peeling knife 10 the wiper blade 22 is also moved towards the filter drum 1 and therefore follows the relative movement of the surface of the filter aid coating 3 such that said wiper blade 22 is in the correct position for the beginning of the next operating cycle (Figure 2).

Obviously, it is possible to peel the filter aid coating (Figure 7) at the end of each operating cycle or only after several operating cycles or only sometimes as required. Under certain conditions the operating stage illustrated in Figure 7 can be omitted and substituted by removing a surface layer of filter aid simultaneously with removing the filter cake during the fifth operating stage as illustrated in Figure 6. The latter mode of operation can be performed if the time interval between removal of the filter cake (Figure 6) and application of further amounts of suspension (Figure 2) is to be kept as short as possible for counteracting entry of air into the filter drum.

During the first operating stage (Figure 2), application of suspension to be filtered can be effected for as long as desired which results in a continuous increase in thickness of the filter cake. When filtering suspensions of low content in solids and giving a permeable filter cake this operating stage can be performed for a comparatively long time. With well permeable filter cakes, the drying time (Figure 4) as well as the displacing time (Figure 5) may be selected to be short. When filtering suspensions of high content in solids which give filter cakes of poor permeability a comparatively long time of application of suspension to be filtered (Figure 2) must be selected and also longer drying periods (Figure 4) and longer displacing periods (Figure 5) must probably be selected in order to remove the filtrate from the filter cake as far as possible. When filtering suspensions the liquid phase of which is of high viscosity, long immersion periods (Figure 2), long drying periods (Figure 4) and long displacing periods (Figure 5) are required. By selecting the time intervals and, respectively, the number of revolutions for each the operating stages illustrated in Figures 2, 4 and 5, the efficiency of the filter can be influenced. If it is desired to keep the efficiency of the filter per surface unit, high said time intervals may be as short as possible. On the other hand said time intervals may be extended if filter aid material is to be conserved. The optimal duration of the operating stages and the optimal number of revolutions of the filter drum during each operating stage may be determined by trial and error.

Figures 8, 9 and 10 illustrate details of the

peeling knife and the cooperating device for cleaning and sharpening the peeling knife. The support 41 carrying the peeling knife 10 is pivotally connected to an axis 42 and actuated by a pneumatic cylinder 12. The scraper 43 is formed of a resilient steel sheet and fixed to an arm extending from the slide 13. The scraper 43 is thus stationarily fixed relative to the pivotal axis 42 of the support 41 for the peeling knife 10, the cutting edge of which is designated 45.

In Figure 8 the peeling knife 10 is shown in an operating position in which said knife is peeling the filter cake 4 off the filter aid coating 3. Particularly when peeling off sticky filter cakes, it cannot be avoided that some of the filter cake material reaches and adheres to the back surface 46 of the peeling knife 10. Such filter cake material detracts from a proper cut and deteriorates the surface of the filter aid coating.

When retracting the peeling knife 10 from the operating position shown in Figure 8, the scraper 43, resiliently engaging the back surface 46 of the peeling knife 10, slides along said back surface 46 and removes the material adhering thereon, as is illustrated in Figure 9.

The peeling knife 10 is then further moved in the end position of its inoperative range as shown in Figure 10 whereby the cutting edge 45 of the peeling knife 10 slides over the scraper 43, which consists of a resilient steel sheet, and is thus subjected to an abrasive action, which results in sharpening the cutting edge 45 of the peeling knife.

In place of the pneumatic cylinders shown in the drawings hydraulic cylinders may be used.

Examples of suitable materials for producing the filter aid coating are potato starch, corn starch, infusorial earth or the like.

The invention provides the advantage that suspensions can be satisfactorily filtered which, up till now, could, in view of unfavourable filtration characteristics, not be or practically not be economically filtered on known rotating filters. Examples for suspensions with such unfavourable filtration characteristics are the following:—

Dregs or sediments occurring in the storage cellars of breweries. Such dregs are suspensions of relatively low content in partially denaturated yeast cells, clouding particles and so on in beer. Filtration of such suspension is much more difficult than filtration of beer yeast.

Wine dregs, i.e. the sediment in wine fermenting vessels. Such suspensions contain partially denaturated yeast cells, cream of tartar, clouding substances and the like in wine.

Autolysed cream of yeast, i.e. a suspension of partially emptied cell walls of yeast in a solution of partially chemically decomposed yeast substances. Such suspensions are obtained when producing yeast extracts and are extremely difficult to filter.

When filtering such suspensions the filter cake as well as the filtrate is to be collected because both are valuable.

WHAT WE CLAIM IS:—

1. A process for filtering a suspension on a rotating filter on which filter the filtrate is drawn into the rotating filter under the influence of a pressure difference and which process comprises the steps of applying said suspension to said filter and filtering the suspension, the application of the suspension to be filtered being interrupted during one or more complete revolutions of the filter to enable the suspension applied to the filter to be filtered off, and subsequently removing a resultant filter cake from the filter.

2. A process as claimed in Claim 1, wherein applying and filtering the suspension and removal of the filter cake is continuously repeated in cycles.

3. A process as claimed in Claim 1 or Claim 2 wherein said filter is firstly provided with a precoat of filter aid material, a portion of the precoating filter aid material being removed when the filter cake is removed.

4. A process as claimed in any one of the preceding claims wherein said rotating filter is a vacuum operated filter drum.

5. A process as claimed in any one of claims 1 to 4 wherein the thickness of the layer of the suspension to be filtered is equalized on the filter at least at the end of applying the material.

6. A process as claimed in Claim 5 wherein the thickness of the layer of the suspension to be filtered is equalised during the total time of applying the material.

7. A process as claimed in any one of claims 1 to 6, wherein the application of the suspension to the filter is interrupted when the filter cake has reached a predetermined thickness.

8. A process as claimed in any one of claims 1 to 7, wherein after interrupting the application of suspension excessive suspension is removed from the filter.

9. A process as claimed in any one of claims 1 to 8, wherein after interrupting the application of the suspension to be filtered onto the filter, filtering of liquid remaining in the filter cake is performed until a predetermined content of liquid in the filter cake is obtained.

10. A process as claimed in any one of claims 1 to 9, wherein prior to removal of the filter cake and subsequent to the interruption of the application of the suspension to be filtered the liquid retained in the capillaries of the filter cake is at least partially displaced by another liquid.

11. A process as claimed in any of claims

1 to 10, performed by means of a vacuum rotating filter drum, wherein the circumferential velocity of the filter drum is within the range 0.5 to 2 m/sec.

12. A process as claimed in claim 11, wherein the circumferential velocity and/or the pressure within the filter drum are maintained constant during the whole operating cycle.

13. An apparatus for performing the process as claimed in any one of claims 1 to 12 said apparatus comprising a trough for a suspension to be filtered and a filter drum for being at least partially immersed into said trough, the interior of said drum constituting a single chamber, means being provided for varying the distance between the axis of the filter drum and the liquid level within the trough between an amount smaller than the radius of the filter drum and an amount greater than the radius of the filter drum.

14. An apparatus as claimed in claim 13 wherein the trough or the filter drum are supported for movement in a vertical direction.

15. An apparatus as claimed in claim 13 or 14, wherein the liquid level within the trough is adjustable.

16. An apparatus as claimed in any of claims 13 to 15 in which the filling height of suspension within the trough is controlled by a floating body, wherein a valve is interconnected into a supply conduit leading into the trough, which renders said supply conduit operative only with the filter drum immersed into the trough or with the immersing body immersed into the trough.

17. An apparatus as claimed in any one of claims 13 to 16 comprising at least one distributing tube for applying a displacing fluid onto the filter drum, the distributing tube being provided with a closure member.

18. An apparatus as claimed in any of claims 13 to 17 comprising a peeling knife for removing the filter cake and, a surface layer of the precoating, if a precoating be provided, wherein the peeling knife is pivotally mounted and is pivotable into the operating position and pivotable out of the operating position.

19. An apparatus as claimed in Claim 18, wherein said knife is pivotable by means of pneumatic cylinders or hydraulic cylinders.

20. An apparatus as claimed in Claim 18 or 19, wherein the peeling knife is supported on a slide arranged for sliding movement towards the filter drum.

21. An apparatus as claimed in Claim 20, wherein a limiter member is arranged on a slide, for limiting the maximal thickness of the suspension to be filtered on the drum driving means for said limiter being positively coupled to the driving means for the slide supporting the peeling knife.

22. An apparatus as claimed in any of claims 13 to 21 comprising a peeling knife movable between an operative position and an inoperative position, and a scraper with which the peeling knife is in sliding engagement during the movement into the inoperative position.

23. An apparatus as claimed in Claim 22 wherein the scraper also engages the cutting edge of the peeling knife in the later stages of the movement of said knife into the inoperative position.

24. An apparatus as claimed in Claim 22 or 23 wherein the scraper consists of a resilient steel sheet resiliently engaging the peeling knife.

25. An apparatus as claimed in Claims 22, 23 or 24 wherein in connection with a pivotally supported peeling knife the scraper is stationarily arranged relative to the pivotal axis of the peeling knife.

26. An apparatus as claimed in any of claims 20, 22, 23, 24 or 25, wherein the pivotal axis of the peeling knife and the scraper are arranged on the slide being shiftable towards the drum.

27. An apparatus for filtering suspensions substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

18. A process for filtering a suspension substantially as hereinbefore described with reference to the accompanying drawings.

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1335094 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

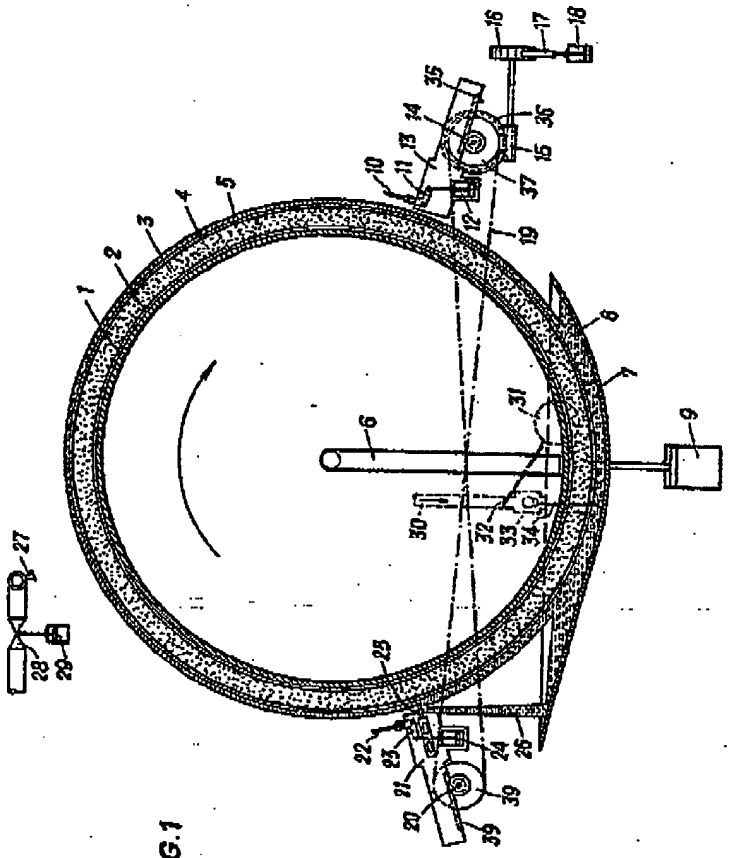


FIG.1

1335094 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

FIG.2

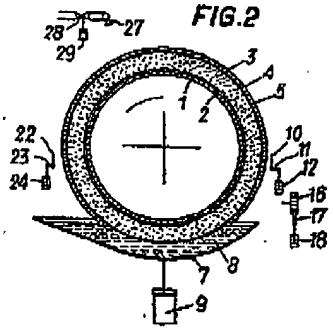


FIG.3

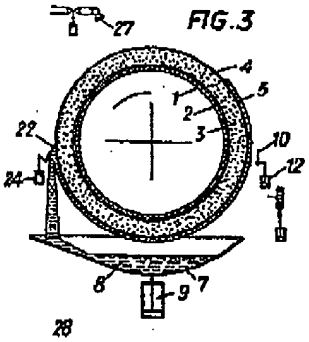


FIG.4

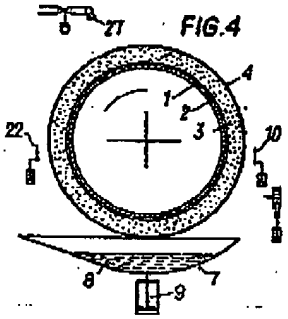


FIG.5

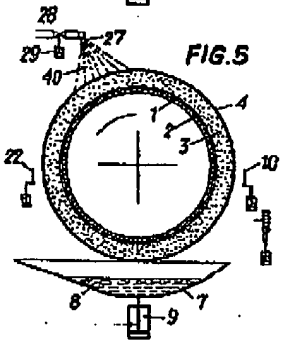


FIG.6

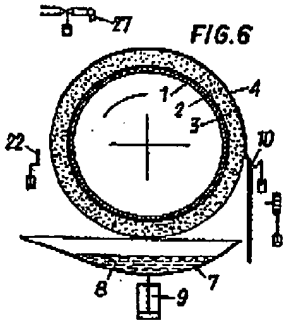
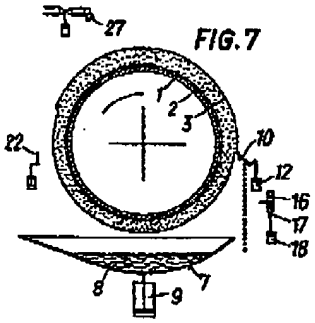


FIG.7



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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

FIG.8

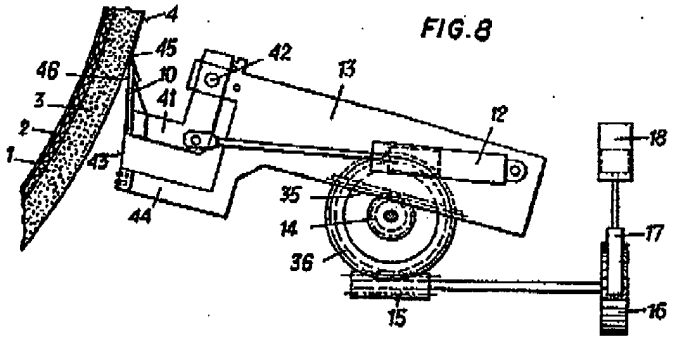

FIG. 9

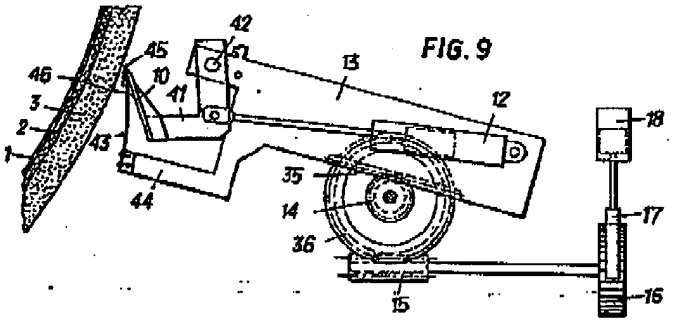

FIG. 10